

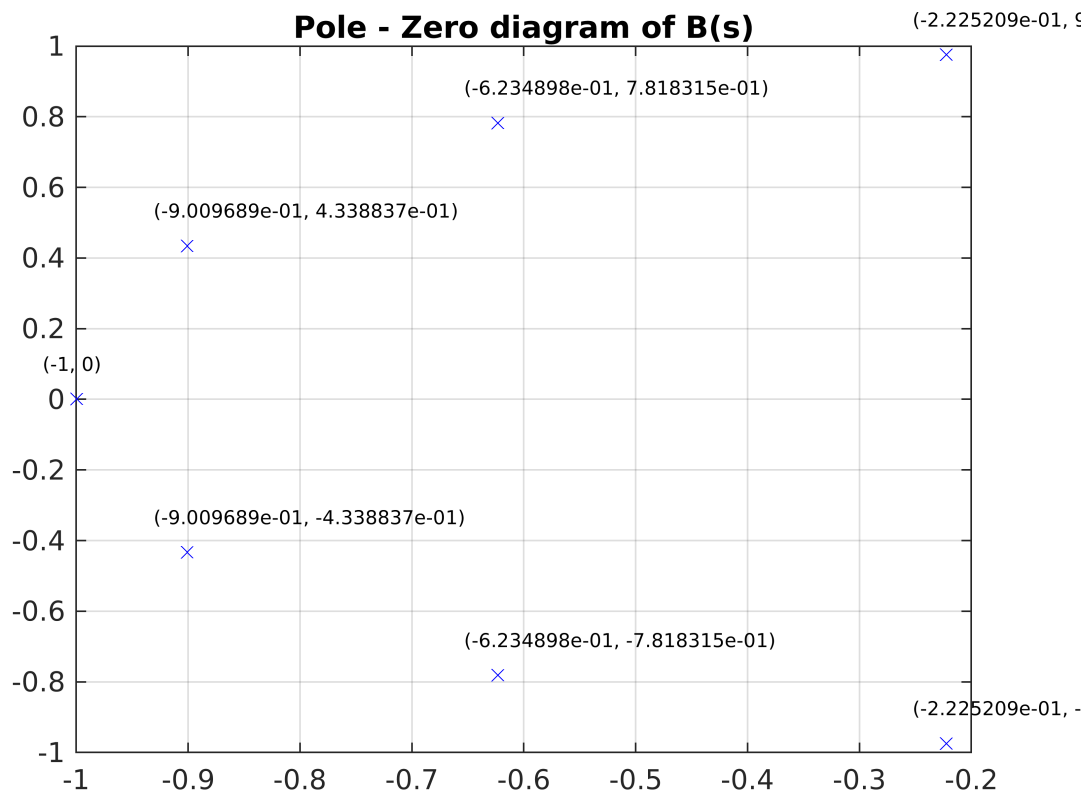
This is Q4 of the assignment

```
n = 7;  
cutoff_freq = 1; % Wc  
f = (1/cutoff_freq)/(2*pi);
```

```
[z,p,k] = butter(n,2*pi*f,'low','s');  
[num,den] = zp2tf(z,p,k);
```

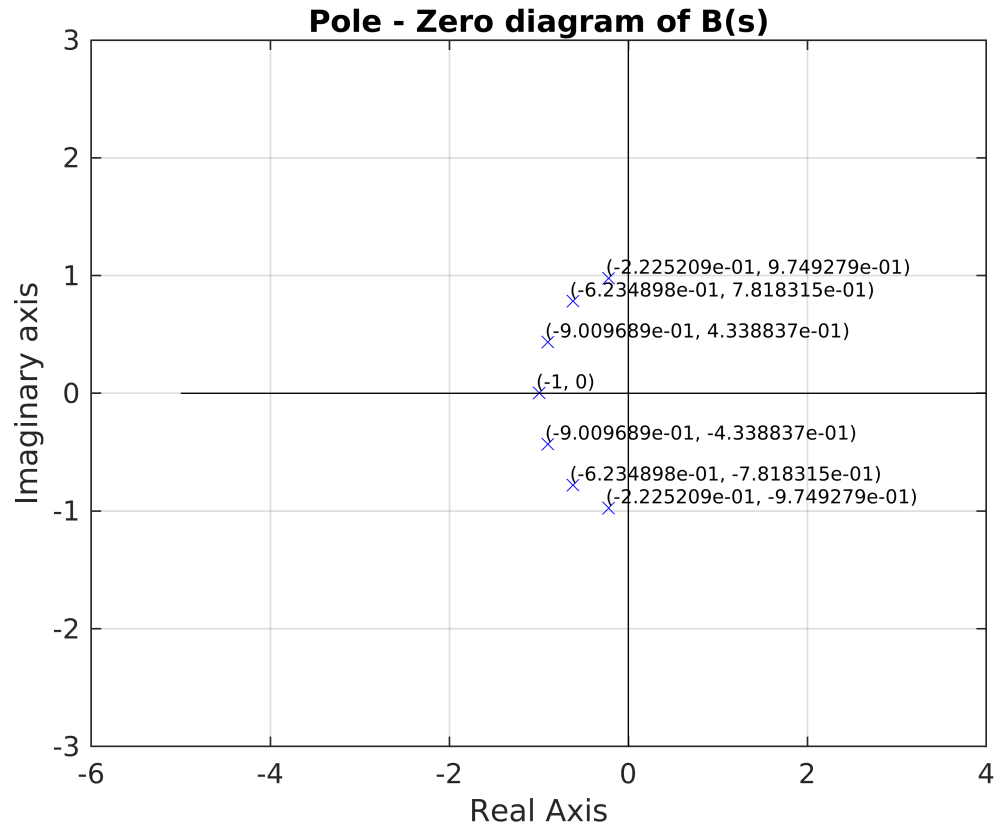
Part (i) of the assignment

```
len_p = length(p);  
  
for i = 1:len_p  
    plot(real(p(i)),imag(p(i)),'bX')  
    textString1 = sprintf('%d, %d', real(p(i)), imag(p(i)));  
    text(real(p(i))-0.03, imag(p(i))+0.1, textString1, 'FontSize', 7);  
    hold on  
end  
  
grid on  
title('Pole - Zero diagram of B(s)')
```



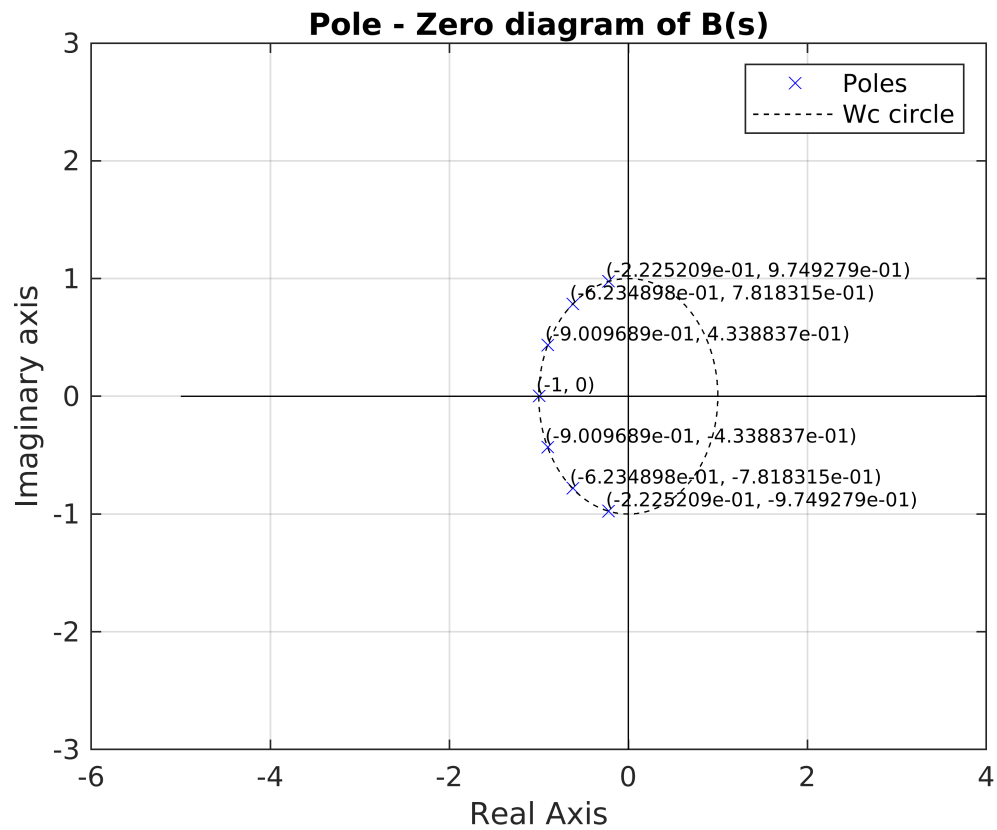
Marking the co-ordinate axis for better view of stability.

```
x_abcissa = [-5 4];  
y_abcissa = [0 0];  
plot(x_abcissa,y_abcissa,'color', 'black');  
xlabel('Real Axis');  
  
x_ord = [0 0];  
y_ord = [-3 3];  
plot(x_ord,y_ord,'color', 'black');  
ylabel('Imaginary axis');
```



Creating the circles now

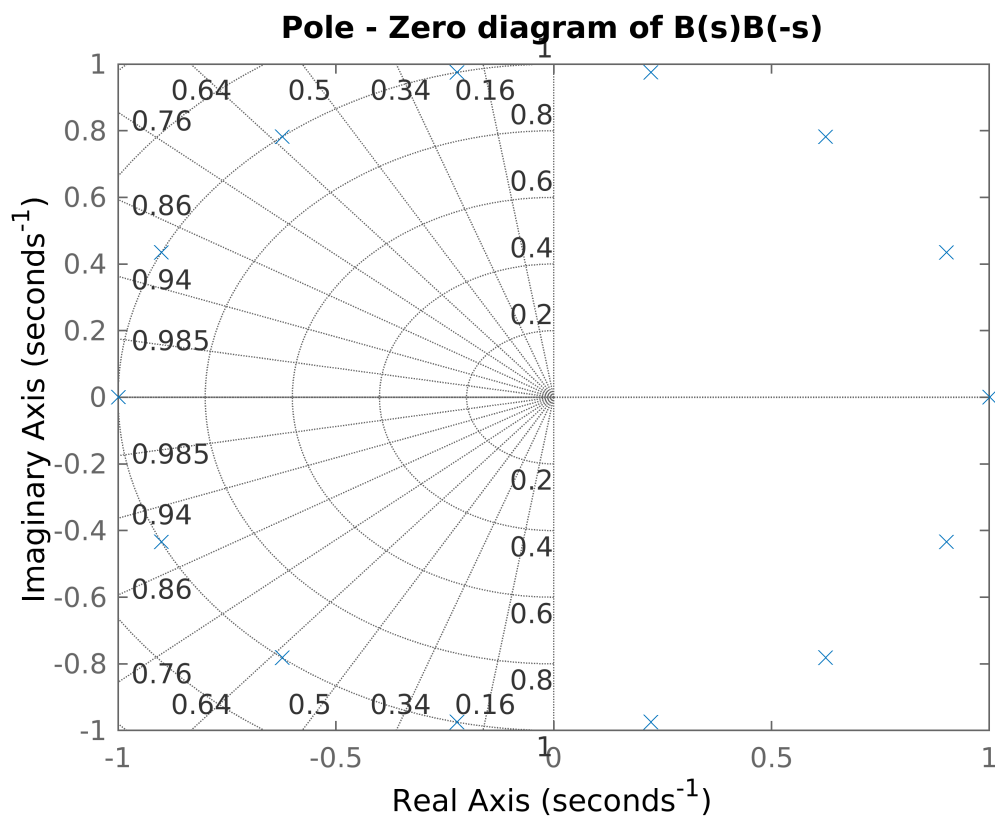
```
% for unit circle:  
a = -pi:0.001:pi;  
x_u_cir = cos(a);  
y_u_cir = sin(a);  
  
plot(x_u_cir,y_u_cir,'k--')  
legend('Poles', 'x', 'Wc circle');  
hold off;
```



Part (ii) of the question

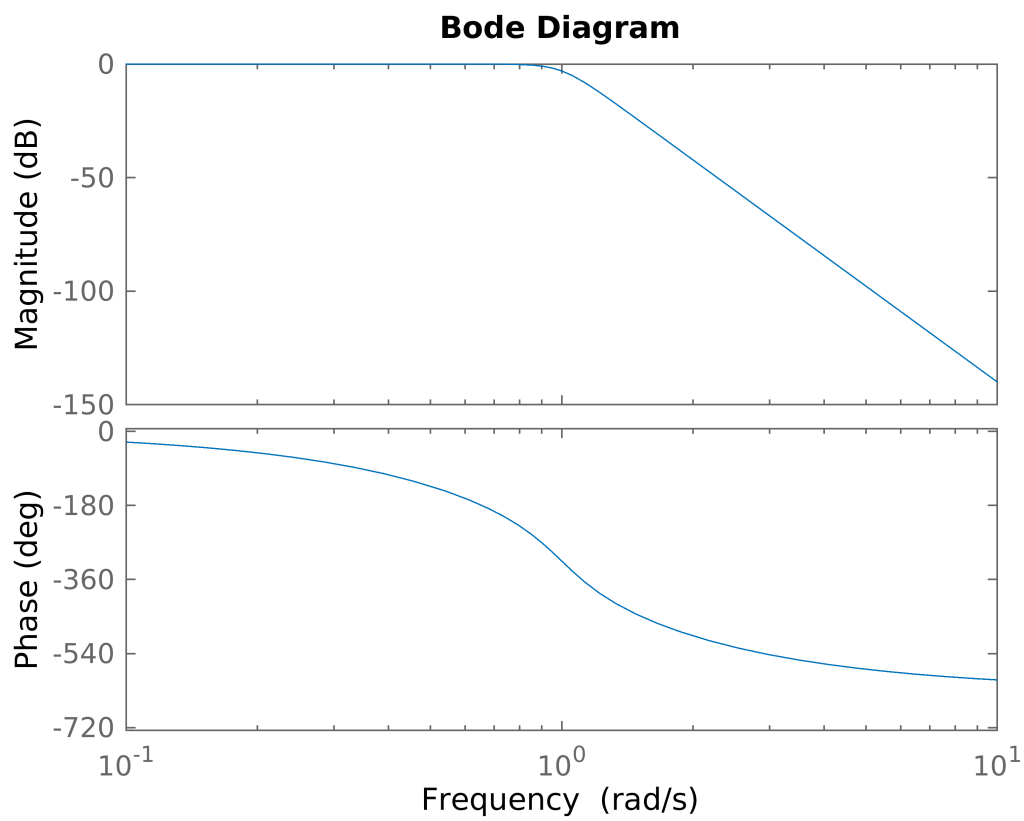
```

Bs = tf(num,den);
Bs_c = ctranpose(Bs);
x = Bs*B_s_c;
pzmap(x);
grid on
title('Pole - Zero diagram of B(s)B(-s)')
  
```



Part (iii) of the question

```
bode (Bs )
```



```
display(Bs);           % Transfer function
```

```
Bs =
```

```

              1
-----
s^7 + 4.494 s^6 + 10.1 s^5 + 14.59 s^4 + 14.59 s^3 + 10.1 s^2 + 4.494 s + 1

```

```
Continuous-time transfer function.
```